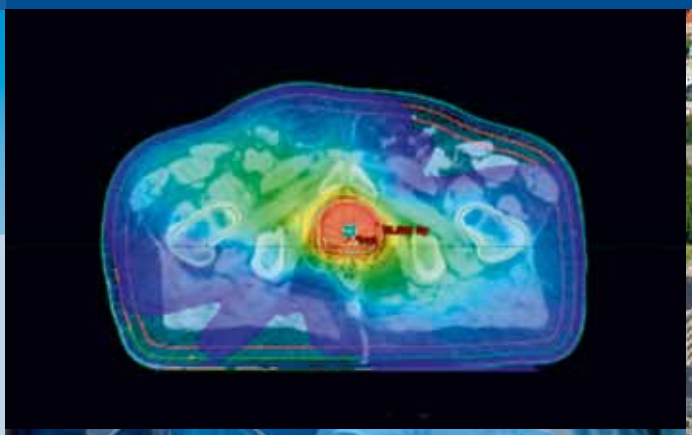
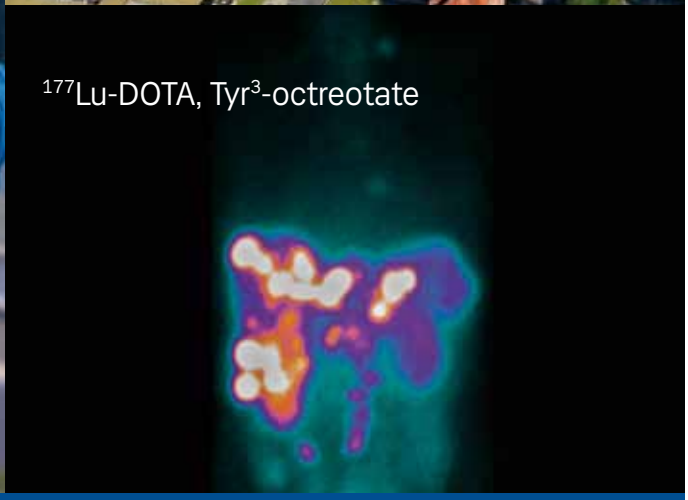
Annual Report 2009

REGION

DEPARTMENT OF CLINICAL PHYSIOLOGY, NUCLEAR MEDICINE & PET





Annual Report 2009

Rigshospitalet · University of Copenhagen

Rigshospitalet

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Rigshospitalet, University of Copenhagen
Rigshospitalet, University of Copenhagen, was founded by King Frederik V in 1757. At present it has 1.200 beds, 8.000 employees and a budget of approximately 0.7 bio €. The research production is more than 1.700 publications per year, including approximately 80 higher academic degrees (PhD and doctoral of medical science). Rigshospitalet is part of The Capital Region of Copenhagen. **www.rigshospitalet.dk**

University of Copenhagen
University of Copenhagen, Faculty of Health Sciences was founded in 1479.
The University is member of The International Alliance of Research Universities.
www.ku.dk

REGION H Rigshospitalet

UNIVERSITY OF COPENHAGEN

Preface

The Department of Clinical Physiology, Nuclear Medicine & PET at Rigshospitalet, University of Copenhagen, had a busy 2009. We carried out more than 30,000 patient investigations and produced more than 80 peer-reviewed papers, including a report of the first randomized controlled trial on the use of PET/CT for staging of lung cancer, published in the influential New England Journal of Medicine.

The financial balance for the Department was positive – as it has been for now 10 years.

The most important tasks for our Department are to deliver the best patient investigation to each individual patient in a respectful, dignified and friendly way; to undertake first class research; and to organize educational programmes for both undergraduate and postgraduate studies for medical doctors, bioengineers, physicists and nuclear medicine technologists.

The highlight of 2009 was the initiation of treatment of patients with neuroendocrine tumors with ^{177}Lu-Dotatate in our new facilities. Previously, patients from Denmark had been treated in Basel in Switzerland, but after a two-year preparatory phase we have now acquired the skills to deliver the treatment with the isotopes produced at the Hevesy Lab at Risø, DTU. In 2009 we gave 46 treatments. For the patients it is both comforting and convenient that they can receive this treatment without travelling to a different country. Our intensive research programme around these patients is part of the Rigshospitalet Neuroendocrine Tumor Study Group (RHINET). Together we have succesfully gained accreditation as a "Centre of Excellence" by the European Neuroendocrine Tumor Society. We would like to take this opportunity to express our thanks to the team behind the new Dotatate treatment. We are impressed by your achievements. A warm thank you!

The Danish journal Dagens Medicin (Medicine of Today) rated our department "Best Department in Denmark" in 2009 on the basis of votes from our colleagues in Denmark. We are obviously very proud of this honour and we are delighted to have been evaluated in such a positive way by our own peers.

We opened the PET/CT scanner number 6 in June 2009 and now have a superb facility with PET/CT scanner 5 and PET/CT scanner 6 adjacent to each other. These two scanners are mainly used for the large daily clinical production of PET/CT scans within oncology. We have a large programme for PET/CT scans within oncology for a variety of cancer diseases for staging, treatment evaluation and relapse evaluation. In addition to our 4,000 clinical PET/CT scans we also performed more than 700 second opinion PET scan readings. (Our clinicians here at the hospital receive PET/CT scans performed outside the Rigshospitalet, and are asked to re-evaluate the scan readings.) In 2009 we also performed 700 PET/CT scans for radiation therapy planning. We would like to thank Professor Svend Aage Engelholm, Chair of the Department of Radiation Therapy, and his team for the excellent collaboration on patient studies, research, development and education. We are proud of our contribution to the advanced radiation therapy here at Rigshospitalet. Also thank you to Ole Bergsten, MTA for help and collaboration.

In the field of PET the number of investigations has increased again and the programme in brain tumors and pediatric tumors has been expanded. The radiochemistry section has expanded the tracerlist. Congratulations to the Radiochemistry Production Team. The Cyclotron Unit has been functioning well and the team has succeeded in extending the CTI-cyclotron to a dual-beam machine. Congratulations!

Our research mission at the department states: "Everything within the framework of nuclear medicine including PET and molecular imaging with animals, translational and clinical studies, development of new isotopes on the cyclotrons, and development of new tracers in the radiochemistry facility, is welcome. The only criterion is quality, quality and quality". Professor Andreas Kjær, who is responsible for our research programme, describes our research in details on page 24.

We have had an excellent research collaboration with Professor Gitte Moos Knudsen and her team at the CIMBI programme. We look forward to continued research collaboration on neurobiology, basic research, translational research and drug development.

We have an extensive programme in Pediatric Nuclear Medicine and PET, focused on delivering the best investigation for each and individual child and family. Our research is performed by MDs in collaboration with nuclear medicine technologists and radiographers and we are member of the Pediatric Nuclear Medicine Network, using telemedicine to provide second opinions across the world.

In the Cluster for Molecular Imaging the combination of animal PET/CT with new tracers and Q-PCR for tumor markers has yielded a remarkably high output of important research. Professor Andreas Kjær and his group are greatly thanked for this impressive effort.

Young students from abroad with high ambitions in research in the broad field of nuclear medicine, PET and molecular imaging are welcome in our Department. In Spring 2009 we had Medical Student Mona Lichtblau from Heidelberg as exchange student and in Autumn 2009 we had Medical Student Yin Wu from University College London. At the moment our staff represent 15 different nationalities. It is a privilege to work in a multicultural environment and although our everyday language is Danish, our research language is English and our researchers and staff are to a large extent proficient in English.

In November 2009 we had an "APV", a mandatory work environment evaluation. The replies from the staff revealed requests for: more space, renovation of the old buildings and better infrastructure. The important message was, however, that the department is functioning well and that the staff are collaborating well and proud of the patient studies, research and education. Thank you to everyone for this positive feedback.

In 2010 we are heading towards a renovation of the radiochemistry lab with new FDG-labs, and we look forward to a continued strengthening of patient investigations in an academic environment based on the most up-to-date infrastructure.

We would like to express a warm and sincere thank you to all staff members for their great effort in 2009, and a warm thank you to all collaborators and partners within the hospital and from abroad.

A special thank you to Dr. Mogens Sandbjerg Hansen, Director of Centre of Diagnostic Investigations, and Karin Nørgaard, Leading Chief Technologist, Centre of Diagnostic Investigations, for excellent help and good collaboration in 2009.

A special warm thank you to Dr. Jannik Hilsted, Medical Doctor, Rigshospitalet for strong support and help with the Dotatate project.

We are looking forward to exciting new challenges in 2010 – for the benefit of patients, research and education!

Liselotte Højgaard and Linda M. Kragh

Mission and Objectives

The mission of Rigshospitalet is to be the leading hospital in Denmark for patients in need of highly specialized treatment.

General objectives:

- to be at the forefront of highly specialized diagnostic treatment and nursing
- to carry out research and development at an advanced international level
- to educate staff in the health services to a highly specialized level
- to contribute with professional advice and exchange of knowledge and expertise
- to the wider healthcare community
- to be characterized by openness and human respect

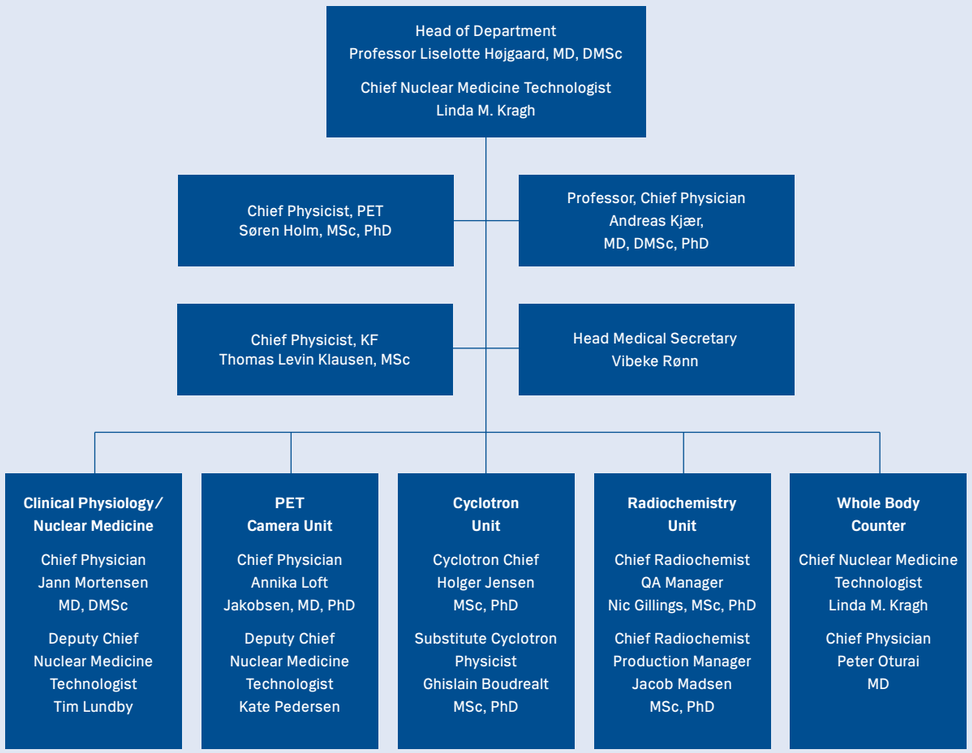
The objectives of The Department of Clinical Physiology, Nuclear Medicine & PET are:

- to provide optimal clinical physiology and nuclear medicine for patient investigation
- to carry out research at the highest international level in clinical physiology and nuclear medicine with special emphasis on molecular imaging, isotopes and radiopharmaceuticals
- to deliver undergraduate and postgraduate education for all relevant professionals within the relevant expert clinical fields, nationally and internationally
- to provide a good patient experience and ensure the wellbeing of the staff

The staff have participated in a number of congresses, symposias, meetings and workshops with invited lectures, oral presentations, abstracts and posters. We have a comprehensive programme for all staff members at the department, and frequent visits from Danish and international research groups.

In 2009 more than 200 groups and individuals visited the department.

Organization and Staff



Department of Clinical Physiology, Nuclear Medicine & PET is part of The Diagnostic Center, headed by Mogens Sandbjerg Hansen, Director, MD, DMSc and Karin Nørgaard, Vicedirector.

Physicians
Ahnlide, Jan, MD, Registrar. Berthelsen, Anne Kiil, MD, Chief Physician. Borgwardt, Lise, MD, PhD, Senior Registrar. Bouchelouche, Kirsten, MD, Senior Reigstrar. Christensen, Charlotte Birk, MD, Registrar. Cronberg, Carin, MD, Chief Physician. Dejanovic, Danijela, MD, Registrar. Dümcke, Christine, MD, Senior Registrar. Graff, Jesper, MD, DMSc, PhD, Chief Physician. Jakobsen, Annika Loft, MD, PhD, Chief Physician. Hasbak, Philip, MD, Chief Physician. Hesse, Birger, MD, DMSc, Chief Physician. Højgaard, Liselotte, MD, DMSc, Head of Department, Professor. Høyer, Alice Outzen Widding, MD, Consultant. Johnbeck, Camilla Bardram, MD, Registrar. Kjær, Andreas, MD, DMSc, PhD, MBA, Chief Physician, Professor. Korsholm, Kirsten, MD, Registrar. Krakauer, Martin, MD, Registrar. Law, Ian, MD, PhD, Chief Physician. Markova, Elena, MD, Chief Physician. Marner, Lisbeth, MD, Registrar. Mortensen, Jann, MD, DMSc, Chief Physician, Associate Professor. Oturai, Peter, MD, Chief Physician. Reichkendler, Michala, MD, Registrar. Nielsen, Dorthe Skovgaard, MD, PhD, Registrar.

PhD students
Binderup, Tina, MSc Human Biology, PhD Student. Erritzøe, David, MD, PhD Student, NRU Researcher. Ettrup, Anders, MSc Human Biology, PhD Student, NRU Researcher. Frøkjær, Vibe, MD, PhD Student, NRU Researcher. Græbe, Martin, MD, PhD Student. Gutte, Henrik, MD, Research Fellow, PhD Student. Haahr, Mette, MD, PhD Student, NRU Researcher. Hansen, Martin, Cand.scient, PhD Student. Jensen, Mette Munk, Human Biology, Research Fellow. Jensen, Torben Hougaard, Cand.scient, PhD Student. Jørgensen, Emilie Arnth, MSc Human Biology, PhD Student. Jørgensen, Jesper Tranekær, MSc Human Biology, Research Fellow. Kalbitzer, Jan, MD, PhD Student, NRU Researcher. Kornum, Birgitte, MSc Human Biology, PhD Student, NRU Researcher. Kristoffersen, Ulrik Sloth, MD, Research Fellow, PhD Student. Louring-Andersen, Julie, MD, Research Fellow, PhD Student. Marthin, June, MD, PhD Student. Nielsen, Kristina Rue, MD, PhD Student. Persson, Morten, MSc, Research Fellow. Pfeifer, Andreas, MD, Research Fellow, PhD Student. Skovgaard, Dorthe, MD, PhD Student. Tägil, Kristina, MD, PhD Student.

Physicists, pharmacists, chemists, technicians, engineers, computer scientists, QA-assistants
Andersen, Flemming, MSc, PhD, Computer Scientist. Boudrealt, Gislain, MSc, PhD, Substitute Cyclotron Physicist. Brandt-Larsen, Malene, MSc, PhD, Chemist. Christensen, Jan Damgaard, Cyclotron Technician. Dahan, Daniel, Cyclotron Technician. de Nijs, Robin, Medical Physicist, MSc, PDEng. Denholt, Charlotte Lund, MSc, PhD, Chemist. Dähnhardt, Andreas, Computer Assistant. Gillings, Nicolas, MSc, PhD, Chief Radio Chemist. Heilmann, Helene, QA-Pharmacist. Hollesen, Christian, MSc Bioengineer, PhD student. Holm, Søren, MSc, PhD, Chief Physicist. Jensen, Bjørn Neumann, Electro Engineer. Jensen, Holger, MSc, PhD, Physicist, Cyclotron Chief. Jensen, Tina Gade, QA-Assistant. Jørgensen, Jesper, MSc, Cyclotron Physicist. Keller, Sune Høgild, MSc, PhD, Computer Scientist. Klausen, Thomas Levin, MSc, Chief Physicist. Madsen, Jacob, MSc, PhD, Chemist, Chief Production Manager. Nielsen, Carsten Haagen, MSc Bioengineer, PhD student. Någren, Kjell, MSc, Research Radiochemist. Olesen, Oline, MSc Bioengineer, PhD student. Sibomani, Merence, IT-expert. Skott, Ulla, MSc, Departmental manager. Szabolcs, Lehel, MSc, PhD, Chemist. Weihrauch, Per, Cyclotron Technician.

Nuclear medicine technologists (NMT), radiographers and nurses
Abrahamsson, Elisabeth, Radiographer. Albers, Mia C. Hjorth, NMT. Christensen, Pia, NMT. Cortsen, Annette, NMT. Dall, Bente, NMT. Dunbar, Douglas, NMT. Elkington, Sakeena, NMT. Federspiel, Marianne, NMT. Frederiksen, Mette Borggreen, NMT. Gudmundsson, Sven, NMT. Hansen, Anja Vallin, NMT. Hansen, Lasse, NMT. Hassan, Mariam, NMT. Heiberg, Therese, Cand.scient.san., NMT. Høybye, Lene, NMT. Jensen, Martin Ravn, NMT. Jørgensen, Hanne, NMT. Jørgensen, Mette Møller, NMT. Kahveci, Zuhal, NMT. Kernchen, Ulla, Staff Nurse. Knudsen, Camilla Sloth, NMT. Kragh, Linda M., Chief NMT. Kronvall, Johanna, NMT. Lindell, Elin, NMT. Linnet, Solveig, NMT. Lundby, Tim, Deputy Chief NMT. Myschetzky, Rebecca, NMT. Nehme, Ghina, NMT. Osinska, Dorota, NMT. Pedersen, Birgitte, NMT. Pedersen, Kate, Deputy Chief NMT. Setterberg, Victoria, NMT. Stahr, Karin, NMT. Svalling, Susanne, NMT. Sørensen, Anne, NMT. Sørensen, Anne B., NMT. Sørensen, Louise Sørup, NMT. Theil, Merete Søndersø, NMT. Wikke, Tina, NMT.

Secretaries
Hansen, Lissa, Secretary. Hildebrand, Sanne, Secretary. Jørgensen, Tina, Medical Secretary. Marquardsen, Joan, Medical Secretary. Myltoft, Mette Gylling, Medical Secretary. Nielsen, Mariane, Service Assistant. Nielsen, Tina Vikmann, Medical Secretary. Nissen, Rikke Gammelbo, Medical Secretary Student. Runge, Gitte, PA to Professor, Medical Secretary. Rønn, Vibeke, Head Medical Secretary. Semitoje, Gudrun, Medical Secretary.

Students
Andersen, Julie Bjerglund. Andreasen, Nis Bo. Christensen, Anders. Christensen, Rune. Dohn, Asmus Ougaard. Jensen, Simon Bøgh. Kamstrup, Andreas. Kjøller, Niels-Kristian. Petersen, Stefan Alaric. Øberg, Mikkel.

Highlights of the year 2009

The highlight of 2009 was the initiation of treatment of patients with neuroendocrine tumors with ^{177}Lu-Dotatate in our new facilities. Hitherto, patients from Denmark have been treated in Basel in Switzerland. The isotope is produced at the Hevesy Lab, Risø, DTU. In 2009 we gave 46 treatments. It is comforting and convenient for these patients that they can be treated in Denmark rather than have to travel to a different country.

On 21st June 2009 The John & Birthe Meyer Foundation donated 2 million Kroners for an automatic chemistry system for our PET and Cyclotron Unit. We are grateful for this generousity. Thank you very much to The John & Birthe Meyer Foundation.

The new PET/CT 6 scanner for clinical oncology patient investigations and our new rooms started to be used in June 2009. The PET/CT 5 and PET/CT 6 scanners next to each other are very fine patient facilities.

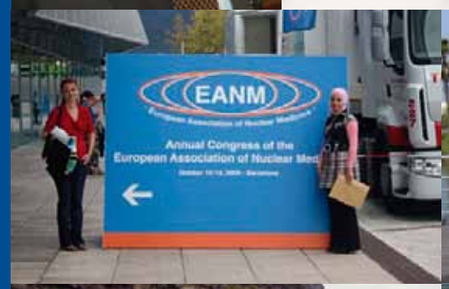
The Department was elected “Best Department in Denmark” in Clinical Physiology, Nuclear Medicine and PET by the Danish journal Dagens Medicin with votes from our collegues in Denmark. We are grateful for this appreciation.

Professor Andreas Kjær and his team at the Cluster for Molecular Imaging presented lectures, talks and posters at many meetings and conferences around the world, reflecting the excellent research activity carried out by the team. Doctors, physicists, bioengineers, chemists, nuclear medicine technologists and secretaries participated in several congresses throughout the year, including those held by AMI, SNM, EANM and gave many lectures all over the world, as reflected in the illustrations. Our Consultant, Dr. Jann Mortensen, MD, DMSc has from 2009 also had responsibility for the Danish National Board of Health Accreditation for the small Department of Nuclear Medicine at the Torshavn Hospital. We are proud of this Nordic collaboration.

At EMRC, the European Medical Research Councils, the highlight of the year was the publication in March of the Forward Look “Investigator-Driven Clinical Trials”, with the aim of improving conditions for clinical research in academia. To pay tribute to our Core Group member Professor Roger Bouillon, Liselotte Højgaard was in Leuven for Professor Bouillon’s’ Retirement Symposium and the old academic traditions at the Leuven University founded 1425 can be seen on the portrait of Professor Bouillon and Professor Højgaard in academic gowns.

Professor Harald zur Hausen, Nobel Laureate 2008, was appointed Honorary Professor in Cancer Virology, University of Copenhagen, Faculty of Health Sciences. Liselotte Højgaard and Harald zur Hausen gave lectures together at the Solstrand meeting “Nordic University Research Conference" in Bergen.

Twice a year we hold a party for the staff. In June 2009 we were in the Tivoli Gardens and in November we had a “Gangster Party” as seen in the illustration opposite. In spite of our serious task of attending very sick patients with the best of our professional skills, it is important that we as staff do our best to collaborate and help each other in a joyful and positive atmosphere.



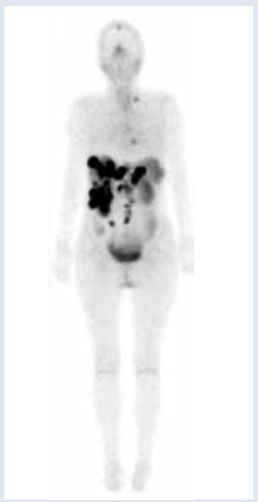
Dotatate

In May 2009, we gave the first treatment with ^{177}Lu-DOTATATE in Denmark to a patient with neuroendocrine tumor metastases. Through 2009 a total of 46 treatments have been given to 16 patients. In collaboration with the Department of Gastro Surgery, Rigshospitalet, and the Hevesy Laboratory at Risø DTU, where the ^{177}Lu-DOTATATE is synthesized and labelled, we treat two patients every week. ^{177}Lu-DOTATATE is administered in our new dedicated facilities in section 4114. Patients stay overnight at the surgical ward before returning to us the next day for scintigraphic imaging to visualize tumor uptake of ^{177}Lu-DOTATATE and for dosimetric calculations. We aim for a total of four ^{177}Lu-DOTATATE treatments over a period of six months in every patient.

The rationale for this new treatment, also called peptide receptor radionuclide therapy, is that the radiolabelled ^{177}Lu somatostatin analogue binds to neuroendocrine tumors expressing somatostatin receptors. The emitted beta-particles from the ^{177}Lu-isotope destroy the tumor cells. In addition the emission of gamma photons from ^{177}Lu allows for scintigraphic imaging and dosimetry.

The indications for ^{177}Lu-DOTATATE therapy are inoperable patients with neuroendocrine tumors that either show progression or cannot tolerate standard treatment. A prerequisite is an ^{111}In-octreotide scan demonstrating a high density of somatostatin receptors in the tumors.

Jann Mortensen and Peter Oturai



Peralust

The world's first randomized study on PET/CT was published in the New England Journal of Medicine in 2009. It was a randomized prospective study of the value of preoperative staging of lung cancer with and without PET/CT from Rigshospitalet. The study was initiated by us in 2000 and performed in collaboration with several departments and hospitals in Denmark. We recruited 189 patients between 2002 and 2007. All PET/CT scans were performed in the Department of Clinical Physiology, Nuclear Medicine & PET, Rigshospitalet. Our main findings were that:

1) more patients were found to be inoperable if PET/CT was included in the staging procedures
2) the frequency of thoracotomies and the frequency of futile (unnecessary) thoracotomies were reduced in the PET/CT group compared to the group without PET/CT. In fact, the absolute reduction was approximately 20%, which means that for every fifth patient that had a preoperative PET/CT, one thoracotomy was avoided.

PET/CT has been placed centrally in the newest Danish guidelines for lung cancer staging (lungecancerpakken). Thus, PET/CT is now mandatory in the preoperative staging of a potentially curable patient according to the Danish National Board of Health.

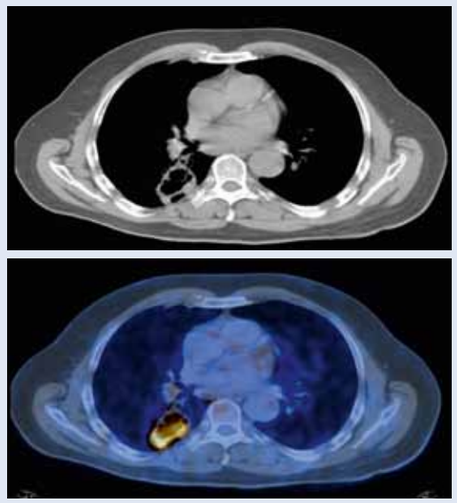
Jann Mortensen

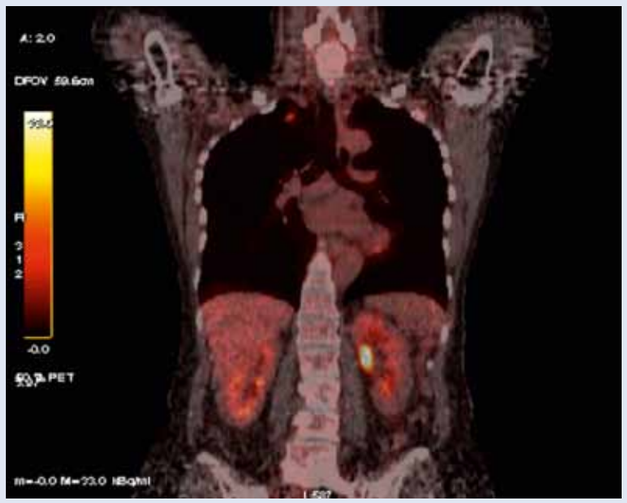
The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Preoperative Staging of Lung Cancer with Combined PET–CT

ABSTRACT





Nuclear Medicine

Weekly receptor targeted radionuclide therapy against neuroendocrine tumors was initiated 2009 in our newly established facilities. This made it possible to avoid sending Danish patients abroad for appropriate treatment. Read more about ^{177}Lu-DOTATATE therapy on page 12.

Many of the patient investigations in the Department of Clinical Physiology and Nuclear Medicine are related to the diagnosis and monitoring of cancer patients. A new single-head camera for monitoring heart function in chemotherapy-treated patients and evaluation of thyroid patients was installed in 2009, and a new ultrasound scanner has improved the evaluation of thyroid patients.

We have eight gamma cameras for routine clinical imaging and human research studies, including three hybrid SPECT/CT cameras, one dual-head gamma camera and four single-head cameras. For lung function testing we have two Jaeger body plethysmographs. In our animal facilities we have SPECT, PET and CT scanners.

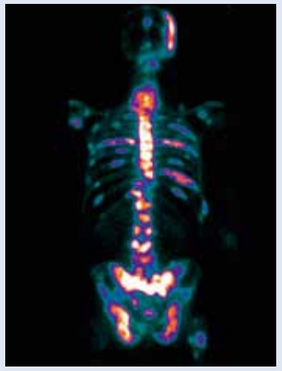
The majority of the hybrid SPECT/CT scans comprise imaging of neuroendocrine tumors, pulmonary embolism and sentinel nodes. The somatostatin receptor ligand ^{111}In-Octreotide imaging is the most important endocrine nuclear medicine imaging modality and is being increasingly used for evaluation and monitoring of radionuclide therapy in patients with inoperable tumors. A large prospective study evaluating the diagnostic power of ^{111}In-Octreotide scintigraphy, FDG PET and ^{123}I-MIBG scintigraphy was completed at the end of 2009.

Three-dimensional physiological and anatomical hybrid imaging using both perfusion and ventilation SPECT with pulmonary low dose CT has been applied for routine diagnosis of pulmonary embolism based on our own research (Gutte et al. *Detection of pulmonary embolism with combined ventilation-perfusion SPECT and low-dose CT: head-to-head comparison with multidetector CT angiography. J Nucl Med 2009; 50: 1987-92).*

Other frequent indications for lung physiology measurements are control after chemotherapy and transplantation or preoperative evaluation and radioaerosol mucociliary clearance investigations for the diagnosis of primary ciliary dyskinesia. The sentinel node technique is increasingly used, leading to optimized surgery of breast cancer, melanoma, oral cancer and other types of cancer.

Radioisotope leakage monitoring procedures are used during isolated limb perfusion with melphalan and tumor necrosis alpha for recurrent melanoma and soft-tissue sarcoma.

Peter Oturai and Jann Mortensen



Pediatric Nuclear Medicine

Each year we perform 1,200 pediatric nuclear medicine investigations mainly for the large pediatric clinics at the hospital. It is a special focus area for our department to perform these investigations at the highest level of excellence, and at the same time ensure that both the child and the parents have a positive experience. Our department is a member of *The Pediatric Nuclear Medicine Network, which is itself part of the the International Telemedicine Network for Second Opinion and Exchange of Ideas*.

The Department has performed pediatric PET scans as a focus area since 1999 and has now performed close to 1,000 scans. Since our introduction of PET/CT in 2001, we now have four PET/CT scanners and perform most of the whole body studies as PET/CT, with only a relevant number as high-resolution CT scans.

Our Pediatric Focus Group is still evolving. Education is a high priority, both internally in the department and externally and our nuclear medicine technologists from the Pediatric Focus Group routinely give talks at our collaborating pediatric departments in order to reinforce the collaboration. This year we focused on systematizing information about the procedures and the scanner performance, in order to continuously increase the quality of pediatric examinations. We have also developed our "flying squad" of pediatric nuclear technologists giving talks at the referring departments. Nuclear Medicine Technologist Marianne Federspiel and Radiographer Elisabeth Abrahamsson gave a very successful talk about Pediatric PET/CT at a course on *Pediatric Radiography* arranged by the Danish Society of Radiology.

To improve the interior design of waiting areas, examination and scanner rooms, our group paid a visit to the *H.C. Andersens Hospital for Children in Odense*. The Children's Programme at Rigshospitalet and our Pediatric Focus Group planned and held the Pediatric Symposium in 2009 at Rigshospitalet to strengthen cooperation between departments and staff concerning pediatric patients throughout the entire hospital and to increase quality of diagnostic examinations, treatment and the experience of the hospitalization of the child and parents. The focus of 2009 was case-presentations of children with CNS-tumors, children with cystic fibrosis and children with psychosomatic diseases. Once again, it was a great success and will be followed by a *Pediatric Symposium in 2010*.

Research in Pediatric Nuclear Medicine and PET is necessary and we conduct research protocols in children with PET and PET/CT in lymphomas, sarcomas, epilepsy, brain tumors and MIBG SPECT/CT of children with neuroblastomas. Research protocols have shown that SPECT/CT can have an increasingly important role within the pediatric area. Performing high quality patient studies based on research is the aim, to assure the best diagnostic investigation for each little patient.

Lise Borgwardt

Cyclotron Unit

In 2009 we experienced, as in previous years, an increase in the need for ^{18}F-labelled FDG, whereas for most of our other isotopes production stayed at a constant level. Almost 20% more ^{18}F-productions were performed, with the major increase on the RDS Eclipse cyclotron. We performed approximately 1,100 successful productions and due to the high flexibility of running two cyclotrons we succeeded getting the fail rate below 0.5%.

In 2009 we started to use the new ^{11}C-methane target for our Scanditronix cyclotron for routine productions. In order to make further developments for the ^{11}C target, we bought an additional target from Scansys intended for more experimental work, and we started to apply the same ideas for improvements of specific activities and target yields at our CTI ^{11}C target.

As a consequence of the increasing demands for ^{18}F-FDG, we upgraded our RDS Eclipse cyclotron with a second beam line and three new targets (^{18}F, ^{13}N and a solid target system). We can now produce twice as much activity using dual beam irradiations (2x60µA), but unfortunately the FDG yields are not scaled in the same way. The chemical yields are considerably lower for dual beam as compared to single beam irradiations.

Holger J. Jensen

Radiochemistry

Routine Production

The demand for ^{18}F-FDG continued to increase in 2009, resulting in a further increase in the number of productions. A new dedicated FDG production laboratory has been designed and will be built in 2010. This is necessary in order to accommodate future demand and to assure that our production continues to live up to the requirements of good manufacturing practice. In 2009 we had some technical problems with FDG production, which led to some delivery irregularities. We apologize for any inconvenience this caused for both our internal and external users. Production of krypton generators continued according to the well-established delivery schedule on Mondays, Wednesdays and Fridays.

Research Production

2009 was a busy year and a large number of different labelled neuroreceptor ligands were produced for use in research projects by the Neurobiology Research Unit at Rigshospitalet (see table). ^{11}C-CUMI 101, a 5HT$_{1A}$ agonist ligand, was approved for human use in 2009 and will be evaluated extensively in 2010. ^{11}C-PIB, the Alzheimer tracer, has been used extensively for research projects, clinical patients and drug trails in 2009. As in previous years we continued to produce ^{13}N-ammonia for cardiac blood flow measurements and ^{15}O-water for cerebral blood flow measurements. Synthesis of a number of new tracers was set up in 2009, including the angiogenesis tracer ^{18}F-Galacto-RGD. A number of other tracers are currently being validated for human use including the cell proliferation tracer ^{18}F-FLT, the hypoxia tracer ^{64}Cu-ATSM, and the neuroendocrine tumor tracer ^{68}Ga-DOTATOC.

Radiopharmaceutical Development

Collaboration with the Neurobiology Research Unit, Rigshospitalet and the Department of Medicinal Chemistry at the Danish University of Pharmaceutical Sciences under CIMBI (Centre for Integrated Molecular Brain Imaging) continued in 2009 and a number of compounds were labelled with carbon-11 and tested in vivo in animals, in our search for a 5-HT$_{2A}$ agonist PET tracer. A very promising tracer has been identified and this will be evaluated in man as soon as possible. Furthermore, we have continued to evaluate a new ^{11}C-methane target, which was constructed in 2008. We have optimized and refined our procedures, which has enabled us to routinely produce carbon-11 labelled radiopharmaceuticals with very high specific radioactivities (up to 2000 GBq/µmol at end of synthesis). This is of paramount importance for the study of low density receptors in the brain.

In collaboration with NeuroSearch A/S, two alpha-7 nicotinic acetylcholine receptor ligands have been radiolabelled and tested in animals, and this has resulted in the best PET tracer for this system to date.

^{18}F-FALGEA, a labelled peptide for imaging the epidermal growth factor tyrosine kinase receptor (EGFR), was developed in the department in collaboration with the Department of Radiation Biology at Rigshospitalet and the Department of Natural Sciences, University of Copenhagen in 2008, and was further tested in 2009 at the Cluster for Molecular Imaging at The Panum Institute. We will apply for funding to continue this promising project in 2010.
Another exciting project involves efforts to label a peptide known to bind to the urokinase-type plasminogen activator receptor (uPAR). The expression of this receptor is elevated during inflammation, tissue remodelling and in many human cancers, in which it frequently indicates poor prognosis. Initial efforts have focused on labelling the peptide with copper-64 and gallium-68, and the in vivo stability of the resultant tracers is currently being investigated. Fluorine-18 labelled analogues will also be evaluated in 2010.

Nic Gillings and Jacob Madsen

Radiopharmaceutical	Batches released for human use			
	2006	2007	2008	2009
^{18}F-FDG	256	268	390	433
^{81m}Kr-Generator	694	869	885	890
^{18}F-Altanserin	42	36	18	14
^{11}C-DASB	47	49	11	21
^{11}C-SB207145	3	20	44	19
^{11}C-PIB	-	-	39	50
^{11}C-Flumazenil	-	1	2	3
^{11}C-CUMI 101	-	-	-	1
^{13}N-Ammonia	97	67	23	32
^{15}O-Water	176	62	146	285
Radiopharmaceutical	**Batches produced for animal/ in vitro studies**			
^{18}F-FLT	-	-	15	19
^{64}Cu-ATSM	-	10	10	15
^{18}F-FALGEA	-	-	5	3
^{18}F-Galacto-RGD	-	-	-	1
^{11}C-Cimbi-5 & analogues	-	-	11	11
^{11}C-CUMI 101	-	-	-	4
^{11}C-NS analogues	-	-	2	12

Summary of radiopharmaceutical productions in 2006-2009

PET/CT scanning in Oncology

Positron emission tomography and its usefulness in oncology are well established. With the introduction of the combined PET/CT scanners, a new world has opened with exciting possibilities.

Our CT scans of PET/CT are performed as high quality diagnostic scans with the use of oral and intravenous contrast media. The PET- and CT-scans are initially interpreted separately by a nuclear medicine physician and a radiologist followed by a joint interpretation of the fused images and a final, combined conclusion taking both examinations into account. This provides the clinician with a more precise PET result, a better CT result, and also a more useful conclusion. The CT result improves in quality because PET can help depict small tumors that can easily be overlooked even by a trained radiologist's eye. The PET positive foci are more precisely determined as correct or false positive with the help of the CT information. Finally, the combined PET/CT conclusion is superior to both scan results alone. Furthermore, the patient is spared from an extra CT examination in the Department of Radiology as well as an extra radiation dose.

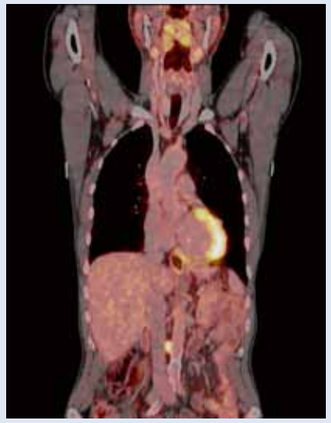
In 2009, we performed 4,500 PET/CT scans of which more than 90% were oncological. The indications are mainly staging, therapy monitoring and detection of recurrent disease in patients with a variety of malignant diagnoses. During the past year we have introduced a supplementary CT of the lungs with 'breathhold' techniques to improve the diagnostic quality. Approximately 50% of our patients participate in clinical research protocols. Our main topics are gynaecology, malignant lymphoma and lung cancer, where the results from our studies have resulted in a paradigm shift with PET/CT at the forefront of diagnostic strategies.

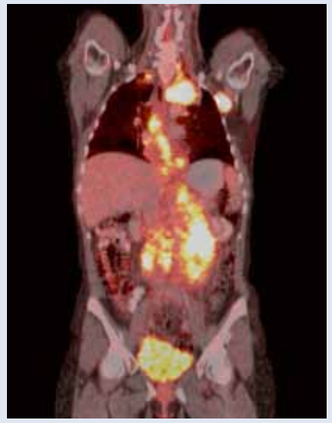
We have nine weekly multidiciplinary team conferences, where our PET/CT scan results are discussed.

FDG is still the main tracer in oncology, but we also use ^{18}F-choline for prostate cancer and ^{18}F-Na F for bone PET scans in research protocols.

Having worked with PET/CT for many years now, we are convinced of the usefulness of PET/CT in everyday clinical work and the research papers that keep coming confirm this impression. However, clinical trials are still necessary to verify the usefulness of the method, to refine the scanning protocols and to develop new indications.

Annika Loft Jakobsen and Anne Kiil Berthelsen





PET/CT scanning in Radiation Therapy

Correct target definition with inclusion of macroscopic as well as microscopic disease in the target volume and sparing of as much normal tissue as possible is the main challenge in curative radiotherapy, particularly with highly conformal treatment methods. The use of PET/CT in radiotherapy planning of cancer patients has increased very rapidly since the method was introduced in 2001.

We cooperate closely with the Department of Radiotherapy on the use of PET/CT for treatment planning of cancer and we do more than 700 PET/CT scans for radiotherapy every year. Our own experience since 2002 is briefly summarized from more than 2,500 patients with various malignant diseases undergoing radiotherapy planning with PET/CT prior to the treatment.

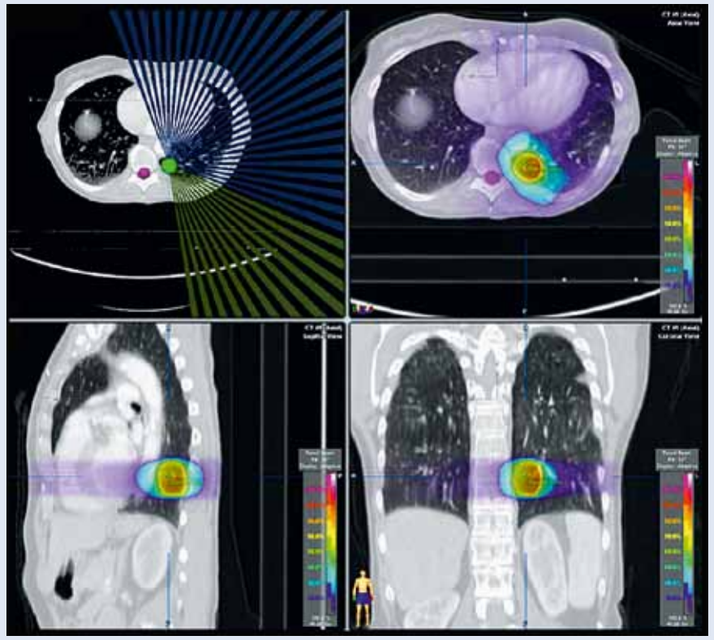
The demanding collaboration between technicians, nuclear medicine physicians and technologists, radiologists and radiology technologists, radiation oncologists, physicists, and dosimetrists must be emphasized.

The advantages of PET/CT are numerous: the anatomical localization and the metabolic activity of the tumor are defined, and the tissue heterogeneity can then be taken into account when choosing radiation technique and energy, and only one scan is necessary. Three of our PET/CT scanners have the possibility of performing PET/CT scans for radiotherapy planning. The nuclear medicine specialist delineates the viable tumors depicted by PET on the fused PET/CT images after interpretation together with the radiologist. The regions are exported to the radiation dose planning system together with the CT scan, and the information is incorporated in the treatment planning.

Research in this field is necessary, and we have conducted trials with nasopharyngeal and cervical cancer and malignant lymphoma with encouraging results. PET/CT for radiotherapy planning is now used routinely for patients with cervical, head and neck, lung, oesophageal, cardiac, rectal and anal cancers as well as malignant lymphoma and mesothelioma. We have an ongoing study using 4D-PET/CT for radiotherapy planning for lung cancer and malignant lymphoma. It is surprising how much the tumor changes morphology during respiration, and we are eagerly awaiting the results!

PET/CT-based radiotherapy planning can improve the therapeutic output in terms of target definition and non-target avoidance and will play an important role in future therapeutic interventions in many malignant diseases.

Anne Kiil Berthelsen and Annika Loft Jakobsen



Dose distribution in a patient undergoing stereotactic radiation therapy for a non-small cell carcinoma

Cardiac Studies

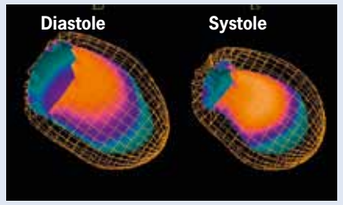
Cardiac SPECT every weekday
Rigshospitalet provide cardiac SPECTs every day. A large proportion of our patients with ischemic heart disease need an acute or sub-acute work-up that requires quick decision-making regarding the coronary revascularization strategy. Patients with unstable angina or nonSTE-MI should be revascularized with percutaneous coronary intervention within three days after admission or with coronary artery bypass graft surgery within 5–7 days according to the Danish National Board of Health. We can now offer acute cardiac SPECT five days a week for those patients who need further evaluation after coronary angiography.

In 2009 our gated cardiac SPECT studies were certified by Cardiovascular Core Laboratories, Inc., Boston, MA, US.

Viability studies with PET
In patients with multi-vessel disease, increased LV volumes and variable degrees of regional and/or global systolic dysfunction, coronary revascularization may lead to symptomatic and prognostic improvement and these clinical benefits are accompanied by evidence of reverse LV remodelling. The main strengths of PET compared with SPECT are its superior spatial resolution and attenuation correction and cardiac PET is generally regarded as the gold standard for viability assessment. Clinical 13NH3 (perfusion tracer) and ^{18}F-FDG (glucose analogue metabolism tracer) scans are performed weekly.

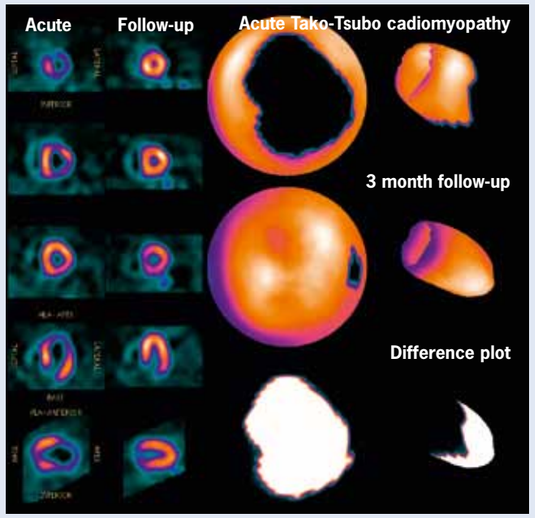
Introduction of coronary artery calcium score
Coronary arterial calcification is part of the development of atherosclerosis, occurs almost exclusively in atherosclerotic arteries, and is absent in the normal vessel wall. Multi-detector computed tomography detected coronary artery calcium can provide an estimate of total coronary plaque burden 1) to assist in coronary heart disease (CHD) risk assessment in asymptomatic patients and 2) to assess the likelihood of the presence of CHD in patients who present atypical symptoms which could be consistent with myocardial ischemia. Coronary calcium measurement by coronary CT scanning is a routine in relevant patients and in accordance with recently published guidelines from the American Heart Association/American College of Cardiology.

Philip Hasbak



Gated cardiac SPECT - Tako-Tsubo in the acute setting with aneurysmal apex and preserved function at the basis of the left ventricle.

Tako-Tsubo,
Japanese for octopus trap.



Myocardial perfusion Images obtained with ^{99m}Tc-Sestamibi at rest during acute onset of Tako-Tsubo and at three month follow-up. The acute images demonstrate a severe perfusion deficit in the apex and the mid-cavity of the left ventricle.
The scan is normal at three month follow-up, illustrating the transient nature of this syndrome.

Tako-Tsubo cardiomyopathy
Transient apical ballooning syndrome is a relatively rare acute cardiac syndrome with a pathophysiology which is not well understood. Patients with this disorder (named after the Japanese word for an octopus trap) often present after an emotionally or physically stressful event with chest pain, electrocardiographic changes, and mild elevation of cardiac markers suggestive acute coronary syndrome. Upon angiography, no obstructive coronary artery disease is identified. Echocardiography or ventriculography typically shows an aneurysmal or dyskinetic apex and mid ventricle with preserved or hyperdynamic function at the basal ventricular level.

Academic Activities

Julie Bjerglund Andersen, Medical Student, is Co-founder of and Vice-chair for PUFF, the organization for young researchers at the Faculty of Health Sciences at the University of Copenhagen, (Panums Ungdoms Forsker Forening: puffnet.dk).

Anne Kiil Berthelsen, Chief Physician, is a member of the Danish Lymphoma Group (DLG).

Lise Borgwardt, Senior Registrar, is a member of the Tumor Board for Pediatric Solid Tumors at Copenhagen University Hospital, Rigshospitalet, external member of the guideline group for Pediatric PET under EANM and Chair of the Pediatric Network Group at Rigshospitalet and Chair of the Pediatric Focus Group at the Department of Clinical Physiology, Nuclear Medicine and PET.

Kirsten Bouchelouche, Senior Registrar, is a member of the ESSIC criteria group in the European Society for the Study of Interstitial Cystitis/Painful Bladder Syndrome.

Christine Winkler Dümcke, Senior Registrar, is a member of the Course Committee at the Danish Society of Clinical Physiology and Nuclear Medicine.

Nic Gillings, Chief Radiochemist, is a member of the management committee of the EU COST Action B12 programme: Radiotracers for in vivo Assessment of Biological Function.

Birger Hesse, Chief Physician, is a member of the European Council of Nuclear Cardiology (ECNC) and Chair of The Medical Research Library at Rigshospitalet, a member of the Cardiovascular Committee at EANM, and a member of the Working Group for Cardiac Imaging at the Danish Society of Cardiology.

Søren Holm, Chief Physicist, is President of the Danish Society for Medical Physics (DSMF), a member of the Educational Board of DSMF and a delegate for the DSMF at the European Federation of Organizations in Medical Physics (EFOMP), a member of an IAEA advisory group concerned with QA/QC and image artefacts affecting quantitation in PET/CT, a member of Sundhedsfagligt Råd i Klinisk Fysiologi og Nuklearmedicin in the Capital Region, the Specialty Advisory Committee (SFR) in Clinical Physiology and Nuclear Medicine, and an external lecturer at Copenhagen University.

Professor Liselotte Højgaard, Head of Department, is Chair of the Standing Committee of the European Medical Research Councils (EMRC) at the European Science Foundation, Strasbourg and member of the Science Advisory Board at the European Science Foundation, a member Conseil d'Administration, INSERM, L'Institut National de la Sante et de la Recherches Medicales, Frankrig, a member of the Science Advisory Board, IMI, the Innovative Medicines Initiative a member of EC FP7 Science Advisory Board in Medical Research, a member of the ESS European Spallation Source, Preperatory Group, University of Copenhagen, a member of the Danish Council for Research Policy, a member of the Council for Medical Museion (Museum of the History of Medicine in Copenhagen). She represents the University of Copenhagen and Rigshospitalet in the programme MSc in Medicine and Technology in cooperation with The Technical University of Denmark (DTU), and is a member of ATV, The Danish Academy of Technical Sciences.

Annika Loft Jakobsen, Chief Physician, is a member of the European Organisation for Research and Treatment of Cancer (EORTC), the Functional Imaging Group, a member of the EANM, AMI, BIR and Oncoradiological Society and Danish Society of Clinical Physiology and Nuclear Medicine, Chair of the Diagnostic Imaging Group under Danish Lymphoma Group (DLG), a member of the Guideline Group for Pharyngeal/Laryngeal Cancer, a member of Regional Working Groups for Cancer treatment: colonic, rectal, lymphoma, malignant mela-noma, a member of National Working Groups for Lymphoma, and a member of the Steering Group for the Danish Liver and Biliary Cancer.

Professsor Andreas Kjær, Chief Physician, is the President of the Scandinavian Society of Clinical Physiology and Nuclear Medicine (SSCP-NM), a member of the Board of the Research Council at Rigshospitalet, a member of the Scientific Committee of the Danish Cancer Society, Editor-in-Chief of Open Neuroendocrinology Journal, leader of the project Molecular Imaging for Testing of New Drugs funded by the Danish National Advanced Technology Foundation, Partner of the Danish Chinese Center for Proteases and Cancer funded by the National Natural Science Foundation of China and the Danish National Research Foundation, Steering Committee member and partner of EATRIS (the European Advanced Translational Research Infrastructure in Medicine) under the EU 7FP, and Head of the Cluster for Molecular Imaging and Director of the Postgraduate School for Molecular Imaging at the Faculty of Health Sciences, University of Copenhagen.

Linda M. Kragh, Chief Nuclear Medicine Technologist, is a member of Sundhedsfagligt Råd i Klinisk Fysiologi og Nuklearmedicin in the Capital Region, the Specialty Advisory Committee (SFR) in Clinical Physiology and Nuclear Medicine, and a member of Uddannelsesrådet for Bioanalytikeruddannelsen i Storkøbenhavn in the Capital Region (the speciality council for the education of laboratory technologists).

Ian Law, Chief Physician, is responsible for the Brain imaging and Oncology specialist courses for Nuclear Medicine Physicians and a member of the Guideline Group for Sarcoma.

Jann Mortensen, Clinical Associate Professor, Chief Physician, is a member of the board of Dansk Selskab for Klinisk Fysiologi og Nuklearmedicin, DSKFNM (Danish Society of Clinical Physiology and Nuclear Medicine), a member of the board of Dansk Endokrinologisk Selskab (Danish Society of Endocrinology) and is on the Steering Committee of Dansk Lungecancer Gruppe (Danish Lung Cancer Group). He is member of the Regionale videnskabsetiske komité F for Hovedstaden (the Regional Ethic Committee), a member of the subcommittees for Dansk Diagnostisk Lungecancer Gruppe (Danish Diagnostic Lung Cancer Group) and Lungecancer Screeningsgruppen (Screening of Lung Cancer Group), a member of the supplementary training committee of the Danish Society of Clinical Physiology and Nuclear Medicine and representative for the Danish Society of Clinical Physiology and Nuclear Medicine in Dansk Medicinsk Selskab (Danish Medical Society). He is a member of the National Working Group for planning clinical guidelines for Lung Cancer workup and the Regional Working Group for implementation of clinical guidelines for Breast Cancer workup. He is responsible for the specialist course in Clinical Respiratory Physiology for nuclear medicine physicians and respiratory physicians, and is section editor of the Clinical Respiratory Journal.

Peter Oturai, Chief Physician, is responsible for postgraduate education. He was a member of the board and Vice President of the Danish Society for Clinical Physiology and Nuclear Medicine (DSKFNM), a representative for DSKFNM in the Danish Medical Society (Dansk Medicinsk Selskab). He is Danish delegate, representing DSKFNM, in the European Association of Nuclear Medicine, in the European Union of Medical Specialists (UEMS), and in the World Federation of Nuclear Medicine and Biology. His is a member of the UEMS – Accreditation of Nuclear Medicine Training Centres Committee, a member of the Board of the Danish Thyroid Association (DTS) and a member of the Danish Thyroid Cancer Guideline Group.

Kate Pedersen, Nuclear Medicine Technologist, is a member of the Technologist Commitee under EANM and member of Udvalget for Ledende og Afdelingsbioanalytikere i Region Hovedstaden under Dbio.

Patient Investigations

CNS and peripheral nervous system	
Regional cerebral bloodflow, rest, ^{15}O-$H_2$0	18
Regional cerebral bloodflow, physiological, ^{15}O-$H_2$0	23
Regional cerebral metabolism, ^{18}F-FDG	279
Regional cerebral metabolism, ^{18}F-Altanserin	20
Regional cerebral receptor, stat. ^{11}C-DASB	20
Regional cerebral receptor, stat. ^{11}C-SB	18
Regional cerebral receptor, stat. ^{11}C-PIB	29
Regional cerebral receptor, ^{11}C-PIB,	25
Regional cerebral receptor, dyn. ^{18}F-AH110690	4
Regional cerebral receptor, dyn. ^{11}C-FMZ	3
Total	**439**

Respiratory organs	
Lung function test, whole body plethysmography w/reversibility	1.235
Lung function test, spirometry, WLHLB +WL1LB	136
Lung function test, spirometry w/reversibility	1.158
Lung function test, spirometry, physiological provocation	167
Lung function test, diffusioncapacity (CO)	17
Lung function test, peak flow w/reversibility	2.632
Max. inspiratoric and expiratoric pressure	1
Lung perfusion scintigraphy, ^{99m}Tc-MAA	35
Lung perfusion scintigraphy, regional, ^{99m}Tc-MAA	164
Lung perfusion scintigraphy, Spect, ^{99m}Tc-MAA	39
Lung ventilation scintigraphy, Spect, ^{81m}Kr-gas	147
Lung ventilation scintigraphy, ^{81m}Kr-gas	140
Lung ventilation scintigraphy, regional, ^{81m}Kr-gas	160
Mucociliary clearance, ^{99m}Tc-venticolloid	49
Total	**15**
	6.095

Heart and cardiovascular system	
Ilsotope cardiography, first pass, ^{99m}Tc-HSA	29
Isotope cardiography, LVEF, ^{99m}Tc-HSA	1.378
Myocardial perf. scintigr. gated, ^{99m}Tc-MIBI, pharmacol. stress, dipy.	7
Myocardial perf. scintigr. gated. ^{99m}Tc-MIBI, pharmacol. stress, dobut.	3
Myocardial perf. scintigr. gated, ^{99m}Tc-MIBI, pharmacol. stress, adeno.	162
Myocardial perf. scintigr. gated, ^{99m}Tc-MIBI, physiological stress	167
Myocardial perf. scintigr. gated, ^{99m}Tc-MIBI, NTG	240
Myocardial perf. scintigr. gated, ^{99m}Tc-MIBI	8
Myocardial ^{123}I-MIBG scintigraphy	1
Calcium score	100
PET myocardial perfusion, ^{13}N-NH_3	23
PET myocardial perfusion, ^{13}N-NH_3, pharmacol. stress, dipy.	6
PET myocardial perfusion, ^{13}N-NH_3, cold press, phys. stress	3
PET myocardial metabolism, ^{18}F-FDG	22
Exercise electrocardiography	21
Total	**2.170**

Peripheral vessels	
Isolated limb perfusion leakage monitoring, chemotherapy	14
Total	**14**

Gastrin intestinal tract, including liver, biliary tract and pancreas	
Bleeding scintigraphy (abdomen), ^{99m}Tc-erythrocyt	3
Biliary tract scintigraphy, ^{99m}Tc-Mebrofenin	16
Meckels diverticulum scintigraphy, ^{99m}Tc-pertechnetat	3
Schilling-test	2
Total	**24**

Kidneys and urinary tract	
Glomerular filtration, ^{51}Cr-EDTA, several samples	192
Glomerular filtration, ^{51}Cr-EDTA, one sample	4.096
Renal scintigraphy, ^{99m}Tc-DMSA	9
Renography, ^{99m}Tc-MAG3, diurese	24
Renography, ^{99m}Tc-MAG3, Dual head	1
Renography, ^{99m}Tc-MAG3	1.877
Renography, ^{99m}Tc-MAG3, ACE-inhibitor	114
Renography, ^{99m}Tc-MAG3 Graft	13
Total	**6.326**

Bone and joint	
Bone scintigraphy, ^{99m}Tc-HDP, regional, static	90
Bone scintigraphy, ^{99m}Tc-HDP, whole body, static	1027
Bone scintigraphy, ^{99m}Tc-HDP, SPECT	35
Bone marrow scintigraphy, ^{99m}Tc-nanocolloid	1
Total	**1.153**

Endocrine organs	
Thyroid scintigraphy, ^{99m}Tc-pertechnetat	502
Thyroid scintigraphy, ^{123}I-jodid	1
Iodine absorption gl. thyroid ^{131}I-jodid	2
Parathyroid scintigraphy, ^{99m}Tc-MIBI, SPECT + CT	58
Tumorscintigraphy, ^{123}I-jodid	85
Whole body scintigraphy, diagnostic ^{123}I-jodide	45
Adrenal marrow scintigraphy, ^{123}I-MIBG	42
Whole body scintigraphy after ^{131}I-therapy	100
Scintigraphy after ^{177}Lu-DOTATATE-therapy	123
Total	**958**

Blood and lymph system	
Erytrocyte volume, ^{99m}Tc-ery	12
Lymph scintigraphy, extremities, ^{99m}Tc-HSA, stases	1
Sentinel node, tumor drainage, ^{99m}Tc-nanocolloid, dynamic	24
Sentinel node scintigr. tumor drainage, mamma c, ^{99m}Tc-nanocolloid	17
Sentinel node scintigr. tumor drainage, malign. mel., ^{99m}Tc-nanocolloid	158
Sentinel node scintigr. tumor drainage, penile c, ^{99m}Tc-nanocolloid	6
Sentinel node scintigr. tumor drainage, vulva c, ^{99m}Tc-nanocolloid	9
Peritumoral injection of ^{99m}Tc-nanocolloid for sentinel node operation	800
Spleen scintigraphy, ^{99m}Tc-erytrocyte, heated	3
Total	**1.030**

Other diagnostic procedures	
Tumor scintigraphy, ^{111}In-Octreotide	271
PET tumor scanning, ^{18}F-FDG	3.719
PET infection scanning, ^{18}F-FDG	56
PET scanning, ^{18}F-FDG	25
PET tumor scintigraphy, ^{18}F-Cholin	13
White blood cell scintigraphy, ^{111}In-Leucocyt	135
Whole body, contamination measurement	36
Image fusion (PET, SPECT, MRI, CT or planar), PET and KF section	4.473
Diagnostic CT, PET	3.442
Diagnostic CT, KF	60
CT-therapy scanning	709
Second opinion description of external PET, PET/CT investigations	633
Digitilization PET images	104
Extra tumor deliniation	43
First pass ^{18}F-FDG tumor scans	27
Supplementary/repeated imaging, PET and KF section	1.485
Investigations without specification	8
^{64}Cu-DOTATATE	5
PET first pass ^{18}F-FDG	22
Total	**15.266**

Radiotherapy	
Treatment with ^{131}I-jodide, benign thyroid	76
Isotope treatment with ^{90}Y-Zevalin	3
Isotope treatment with ^{177}Lu-DOTATATE	46
Total	**125**

Total number of patient investigations:	**33.600**

Animal Studies

Rabbits	^{99m}Tc-Nanocoll	4
	^{111}In-labelled antibodies	4
Rats	^{18}F-FDG	65
Mice	^{18}F-FDG	354
	^{18}F-FLT	99
	^{18}F-Galacto-RGD	1
	^{64}Cu-ATSM	120
	^{64}Cu-DOTATATE	41
	^{64}Cu-Nanoparticles	10
	^{64}Cu-AE105	30
	^{68}Ga-DOTATOC	31
	^{117}Lu-DOTATATE	23
Pigs	^{15}O-H2O	1
	^{18}F-FDG	1
	^{11}C-cerebral receptor (NRU)	13
Dogs	^{64}CU sarcom ATSM	6
	^{18}F-FDG	6
	CT-scanning, perfusion	8

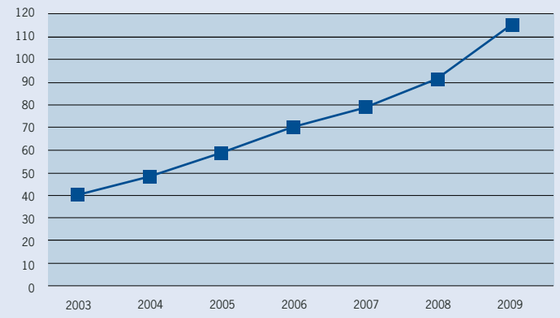
Total number of animal studies:	**819**

Finance

BALANCE 2009

Expenditure			
Running costs	DKK	17.8	million
Staff	DKK	43.9	million
In total	**DKK**	**61.7**	**million**
Receipts	DKK	19.4	million
Net sum	**DKK**	**42.3**	**million**

TURNOVER 2003-2009



Research

A strong focus on research is a cornerstone of the department. We have an extensive research programme and collaborate with several national and international partners. Our research focuses on development of new tracers for PET and nuclear medicine, on clinical evaluation of new diagnostic methods, and on the use of methods from clinical physiology and nuclear medicine to study pathophysiology. Translational research in the area of molecular imaging is currently given special attention in order to reduce time from development to use in patients. Some current areas of major research are detailed below.

New tracers

Several projects aimed at the development of new, specific tracers for non-invasive tissue characterization are currently undertaken. These tracers are to be used for the diagnosis of different cancer types as well as for planning and monitoring therapy. The projects, translational in nature, are carried out in collaboration with other departments and laboratories to ensure expertise in molecular biology, chemistry, radiochemistry, cancer biology and imaging. For validation of tracers, we also have molecular biology and biomarker laboratory facilities at the department. In collaboration with a pharmaceutical company and supported by the Danish National Advanced Technology Foundation, we have established a molecular imaging platform for testing of new anti-cancer drugs and for tailoring anti-cancer therapy.

Clinical PET/CT

A large number of prospective protocols are performed to evaluate the diagnostic and prognostic value of PET/CT with different tracers in various forms of cancer in children and adults. Head-to-head comparison studies of new PET tracers and established imaging methods are also performed. The use of PET/CT for the planning of radiation therapy (IMRT, "dose-painting") and the use of respiratory gating are also currently being evaluated.

Pediatric nuclear medicine investigations

The department conducts many pediatric investigations. Several research protocols with the use of PET and SPECT are carried out in cooperation with clinical departments, particularly within oncology.

Neuro PET

With the use of PET/CT, including HRRT, studies on brain tumors are undertaken. Studies of brain perfusion using PET or DCE-CT are also performed. In addition, imaging of dementia with new tracers is studied. In cooperation with Professor Gitte Moos Knudsen's group in the Neurobiology Research Unit and Centre for Integrated Molecular Brain Imaging, neuro receptor ligands have been developed and used for research in neurobiology. The focus has mainly been on the serotonergic system.

Atherosclerosis

With the use of PET/CT we can non-invasively visualize atherosclerosis and predict vulnerability of atherosclerotic plaques. Several studies in different groups of patients at risk are currently undertaken.

Nuclear cardiology

With the use of PET, coronary flow regulation is studied in connection with gene therapy and pharmacological interventions in a variety of disease states. With the use of SPECT/CT the development of ischaemic heart diseases is studied in selected groups of patients.

Lung studies

Research is being conducted into mucociliary clearance of the nose and lungs, and lung function testing and lung scintigraphy in different patient groups, e.g. lung transplantation. The value of combined use of SPECT/CT for diagnosing pulmonary embolism has recently been evaluated. Animal experiments investigating deposition characteristics are other examples of current lung research.

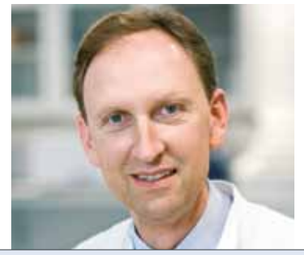
Radionuclide treatment

Localized radiation therapy using specific ligands binding to certain cancer forms has recently been implemented. The department takes part in research within this area by testing new ligands and producing relevant isotopes. Cancers that are currently being targeted include certain types of lymphoma, ovarian cancer and neuroendocrine tumors. Treatment will in part be based on imaging using new tracers for molecular profiling for optimal outcome and fewer side effects.

Whole body counting

Together with external partners, whole body counting is used for exact measurements of body composition in a series of studies. In addition we are investigating absorption of certain minerals from the gastrointestinal tract.

Andreas Kjær



Cluster for Molecular Imaging

The change in paradigm towards individualized, tailored therapy has led to an increasing need for diagnosing at the molecular level. Most of the molecular biology methods used today need tissue sampling for in vitro analysis. In contrast, molecular imaging allows for non-invasive diagnosis at the cellular and molecular level in the living, intact organism. With PET it is possible to label a whole new group of biomolecules with radioactive isotopes to be used for visualization of, for example, metabolism, receptors and gene-expression. Especially within cancer biology, but certainly not limited to this, these techniques are expected to lead to a breakthrough in diagnosis and treatment. Of the different methods for molecular imaging only the nuclear medicine based techniques are of a true translational nature, i.e. methods developed in animal models may directly be transferred to and used in humans.

Our current molecular imaging research programme is aimed towards the use of molecular biology and imaging techniques in both animals and humans to develop, evaluate and use non-invasive molecular imaging for human tissue characterization.

Two major applications of these tracers are anticipated: 1) planning of individualized, tailored therapy, and 2) testing of new drug candidates.

The development of new molecular imaging tracers for PET is a very complex process that involves many steps from definition of target to final use of the tracer in patients.

Main steps involved in tracer development and use

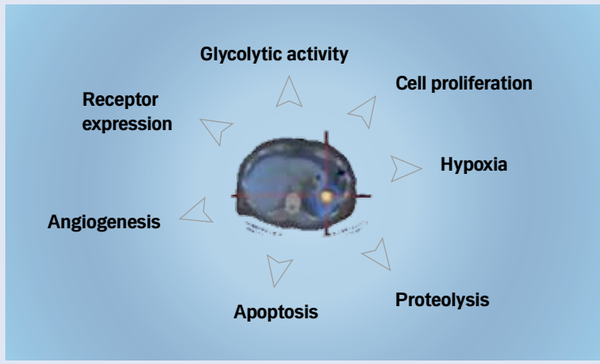
- Selection of key-processes involved in the pathophysiology of the disease
- Definition of relevant molecular targets of the key-processes
- Design of specific ligands
- Radioactive labelling of ligands
- Test of imaging ligands in relevant animal models
- Use of imaging data for therapy planning and monitoring of response
- Use for diagnosis, therapy planning and monitoring in patients
- Use in testing of new drugs

Through the formation of the Cluster for Molecular Imaging at the Faculty of Health Sciences, University of Copenhagen (headed by Professor Andreas Kjær) a core facility at the Panum Institute for molecular imaging in animals with PET, SPECT and CT has been established. This has improved our translational capacity since we are now able to test new tracers in animal models prior to clinical use. In accordance with this we have currently several new tracers in pre-clinical testing in animal models that are already or soon will become available for human use.

The Cluster for Molecular Imaging is imaging partner in the European Advanced Translational Infrastructure in Medicine (EATRIS) under EU 7FP.

Currently the main focus of translational research in tracers for non-invasive tissue characterization is on their use in cancer and cardiovascular disease. However, several other applications are also foreseen.

Andreas Kjær



Some tissue characteristics currently targeted for imaging

Publications 2009

Doctoral Thesis
Pinborg L. Molecular Imaging of receptors and transporters in humans using PET and SPECT: from models to methods and potentially to pitfalls. Defended June 4th 2009 at University of Copenhagen, Faculty of Health Sciences.

PhD Thesis
Bie-Olsen LG. Influence of hypoglycaemia and basal renin-angiotensin system activity on regional cerebral blood flow different cognitive loads, a H2150 PET study. Defended September 4th 2009 at University of Copenhagen, Faculty of Health Sciences.

Chakera A. Technical challenges and clinical implications of preoperative sentinel node identification in breast cancer and cutaneuous melanoma. Defended May 19th 2009 at Rigshospitalet, University of Copenhagen, Faculty of Health Sciences.

Erritzoe D. *In vivo* serotonergic markers in overweight and schizophrenic human subjects. Defended April 17th 2009 at University of Copenhagen, Faculty of Health Sciences.

Kaltbitzer J. The serotonin transporter and behavior. Gene environment interactions. Defended November 16th 2009 at University of Copenhagen, Faculty of Health Sciences.

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Marner L. Molecular brain imaging of the serotonin system: Reproducibility and evaluation of PET radiotracers. Defended March 13th 2009 at University of Copenhagen, Faculty of Health Sciences.

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As in previous annual reports we have chosen to list scientific papers, and not the many abstracts and proceedings from the department.

Danish–Chinese Scientific Collaboration

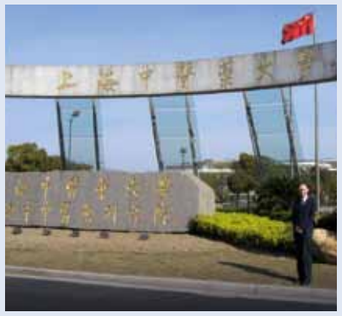
The Department has over the last year continued and expanded collaboration with several Chinese partners within the field of molecular imaging.

Professor Andreas Kjær is partner in the Danish Chinese Center for Proteases and Cancer funded by the The National Natural Science Foundation of China and the Danish National Research Foundation. The centre was established to strengthen cancer research leading to tailored therapy. Participants are in addition to Rigshospitalet, Aarhus University and Chinese researchers from the Chinese Academy of Sciences, Fuzhou and University of Hubei. The centre is headed by Professor Peter Andreasen, Institute of Molecular Biology, Aarhus.

In 2008 professor Andreas Kjær was selected to participate in the Danish–Chinese Partnership for Joint Benefit programme as part of the Asia strategy of the Danish Government to strengthen Danish–Chinese collaboration. This has led to formalized research collaborations with several partners in China.

With Shuguang Hospital in Shanghai a programme using PET for non-invasive testing of Chinese anti-cancer treatments has started. The programme includes pre-clinical animal models as well as testing in cancer patients in China. The research collaboration is supported by the Danish Ministry of Health and Prevention.

Recently a research collaboration between Shanghai Innovative Research Center of Traditional Chinese Medicine (SIRC/TCM) and our department has been initiated. SIRC is supported by Ministry of Science and Technology of China and located in the Pudong Hi-Tech Park in Shanghai.



Professor Andreas Kjær visiting Shuguang Hospital in Shanghai together with representatives from the Danish Ministry of Science, Technology and Innovation.

Shuguang Hospital in Shanghai.

DANISH-CHINESE CENTRE FOR PROTEASES AND CANCER
THE DANISH NATIONAL RESEARCH FOUNDATION AND
THE NATIONAL NATURAL SCIENCE FOUNDATION OF CHINA

Grants and Foundations

Liselotte Højgaard has received 2 mio. DKK from The John and Birthe Meyer Foundation for a radiochemistry automatic system for tracer production.

Kirsten Bouchelouche has received 50,000 DKK from Region Zealand for the project *"Effect of sarcosine on HER2 expression in prostate cancer cells" and 120,000 DKK from Køge Hospital for the project "Cellular methods for evaluation of new imaging agents and targeted radionuclide therapy of HER2 positive cancer".*

Tina Binderup, MSc Human Biology, PhD student, received a young investigator travel award for her presentation at the World Molecular Imaging Conference, Montreal, Canada, September 2009.

Mette Munk Jensen, MSc Human Biology, PhD student, received a young investigator travel award for her presentation at the World Molecular Imaging Conference, Canada, September 2009.

MSc in Medicine and Technology

In cooperation with the Technical University of Denmark (DTU) and the University of Copenhagen (KU), the Department represented by Professor Liselotte Højgaard is involved in the MSc programme in Medicine and Technology. It is a five-year bioengineering degree at bachelor and master's level. The first master's graduated in 2008 with a big party celebrating the first candidates at DTU on September 19th, 2008. Since the launch of the programme in 2003 more than 200 students have applied for the 60 available places each year. You can read more about the programme at www.medicin-ing.dk

At present three of these bioengineers are seconded to the Department as PhD students and we have numerous students working with bachelor's and master's reports in collaboration with DTU, IMM (Institute for Mathematical Modelling), Professor Rasmus Larsen and DTU, Electro with Professor Jørgen Arendt Jensen.

In 2010 the course will be subject to an accreditation and the programme leader, Professor Jørgen Arendt Jensen, DTU Electro and the team are awaiting this with positive entusiasm.

A warm thank you to Professor Jørgen Arendt Jensen, Associate Professor Kaj-Åge Henneberg and Reader Jens E. Wilhjelm, DTU and Associate Professor Bente Stallknecht, University of Copenhagen, for their great effort and our great collaboration both on education and research.

DTU

UNIVERSITY OF COPENHAGEN

Liselotte Højgaard was appointed Adjunct Professor in Advanced Medical Imaging at DTU, Spring 2009.

Cimbi
Center for integrated molecular brain imaging

Center for Integrated Molecular Brain Imaging
University of Copenhagen, Rigshospitalet

In cooperation with the Neurobiology Research Unit, Professor Gitte Moos Knudsen and Professor Olaf B. Paulsson, a series of neuroreceptor ligands are being developed and used for research in neurobiology. The focus has mainly been on the serotonergic system. In 2005 Gitte Moos Knudsen received a grant from the Lundbeck Foundation and established CIMBI, Center for Integrated Molecular Brain Imaging, where we are proud to collaborate on the PET studies.

Education

Education at different levels for various health related professionals is a central activity of the Department of Clinical Physiology, Nuclear Medicine & PET. The department participates in undergraduate education at the Faculty of Health Sciences at the University of Copenhagen for medical students, human biology students and bioengineer students in collaboration with DTU in many subjects, e.g. clinical physiology, nuclear medicine, theoretical physiology and medical technology. Nuclear medicine technology students and radiography students receive part of their education from the department.

In postgraduate education, the department contributes to the specialist education of physicians in clinical physiology and nuclear medicine. The dedicated courses in *oncology-, cardiology-, lung-, and endocrinology-pathophysiology* for this specialist education are all held at our department and arranged by our chief physicians and we contribute to the specialist education of physicians from other specialities such as radiology, oncology, haematology and thoracic surgery.

A high number of PhD students are associated with research activities in the department.

All staff members participate in the department's educational activities. The *CT course for nuclear medicine technologists*, officially acknowledged by the National Institute of Radiation Protection, is arranged by and held at the department. Technologists from the department at Rigshospitalet and from departments all over Denmark have participated in the courses, which include 80 lectures and tutorials. This allows the staff to be in charge of the PET/CT and SPECT/CT scanners, while also contributing to the CT aspects of the course. The department also delivers extensive training programmes to staff from other nuclear medicine and radiology departments in Denmark and the Nordic countries. Study visits to our facilities from physicians, students and nuclear medicine technologists for periods ranging from a few weeks to six months have been arranged.

The department's educational activities have been accredited by both the *Danish National Board of Health* and by *the Accreditation of Nuclear Medicine Training Centres Committee of the Section of Nuclear Medicine of the European Union of Medical Specialists (UEMS).*

Chief Physician Peter Oturai is responsible for postgraduate education of physicians in the department. Clinical Associate Professor Jann Mortensen is responsible for undergraduate education of medical students. Professor Liselotte Højgaard is responsible for under- and postgraduate education for bioengineers.

Peter Oturai and Jann Mortensen

Nuclear Medicine Technologists

The nuclear medicine technologists perform the daily production of radiopharmaceuticals and perform the daily clinical patient investigations in collaboration with the physicians. Moreover they also participate in research and development projects. They have co-responsibility for several projects and are involved in booking, data management, quality assurance, patient and animal studies. Research results are disseminated through oral presentations and posters at both Danish and international meetings and symposia for technologists.

Research

All projects at the department have a nuclear medicine technologist associated with the protocol and the nuclear medicine technologists are responsible for practical procedures throughout the project. Many research projects are performed outside standard hours, such as the HIV CACS project. Here, myocardial perfusion and calcium score were investigated in HIV positive patients and a control group. This project involved 100 patients, and the nuclear medicine technologists worked Saturdays and Sundays to complete the project.

Education

The nuclear medicine technologists have throughout the year participated in supplementary training and our technologists and radiographers were teachers on courses at the Metropolitan University College, Copenhagen. Our nuclear medicine technologists are frequently asked to provide courses and give lectures both in Denmark and at the PET/CT course in Vienna.

Nuclear Medicine Technologist Therese Heiberg graduated as Cand. Scient. San. with the project: "*Dosimetric considerations regarding ^{177}Lu-Dotatate patients, implementation of treatment in the Nuclear Medicine Department, Rigshospitalet*".

Nuclear Medicine Technologist Teacher Pia Christensen graduated in her diploma study with the thesis *"How learning environments can promote learning"*.

Six nuclear medicine technologists have participated in a course on sterile working techniques to meet the GMP requirements for work on labelling of blood cells.

Eight nuclear medicine technologists participated in our own dedicated CT course, gaining competence to perform PET/CT and SPECT/CT scans. The course is officially recognized by the National Institute of Radiation Protection.

We continuously educate nuclear medicine technology students and normally we have between three and six students in the department.

According to a new directive from the Danish Government all radiography students are obliged to have a two-week internship in nuclear medicine and in December we welcomed the first seven radiography students for a two-week internship with great success.

In Autumn 2009 four nuclear medicine technology students completed their BA, and they will defend their project reports in 2010.

New procedures

The Department has implemented the radiopharmaceuticals treatment ^{177}Lu-Dotatate in patients with neuroendocrine tumors. Our Nuclear Medicine Technologist Solveig Linnet and Nuclear Medicine Technologist Mette Frederiksen have together with our chief physicians implemented the procedure with fine results.

A new PET/CT-scanner 6 arrived in June 2009 and Nuclear Medicine Technologists Camilla Knudsen and Karin Stahr have participated in the commissioning of the scanner.

International affiliations/meetings

Marianne Federspiel has replaced Kate Pedersen, as a member of the EANM Technologist Committee.

Nuclear Medicine Technologist Marianne Federspiel and Radiographer Elisabeth Abrahamsson were invited speakers at the ESTRO-meeting in Maastricht presenting the lecture *"Workflow overview in PET/CT therapy planning"*.

At the EANM congress in Barcelona we presented three posters:
E. Abrahamsson, M. Federspiel with *"Implementation of a new image reconstruction method for clinical purpose"*,
T. Heiberg with "Setting up a treatment scheme for ^{177}-Lutetium-Dotatate", and
G. Nehme, M.H.B. Frederiksen with *"Is monitoring of ejection fraction necessary in patients treated with cardiotoxic drugs for multiple sclerosis?"*

One oral presentation was presented:
B. Dall with the lecture *"Technical and psychological aspects regarding patient preparation, and performing high quality brain PET scanning in patients with brain tumors, dementia and epilepsy"*.

Linda M. Kragh

PET and PET/CT Scanners

New brain projects have been initiated on our dedicated brain scanner, the HRRT (High Resolution Research Tomograph). Originally intended – as the name indicates – mainly for research, the HRRT has now also become a clinically useful instrument. Designed by a collaboration of several research groups in Europe and USA, and built by CTI in Knoxville, Tennessee (now owned by Siemens) the HRRT project has a ten-year history that finally resulted in the building of one series of 18 instruments; the Copenhagen installation is among the last of these, but nevertheless at the forefront of the application of this technology.

Technically, the HRRT has a record high number of detector crystal elements (119,808). The enormous amount of data these detectors create has always been a major challenge, but continuous improvement in computer performance has now reached a practical level where image reconstruction times are comparable to the acquisition time. The images provide a resolution of 2–3 mm in the full field of view by standard reconstruction methods, but by using improved reconstruction software (PSF-based) this can be reduced to 1.5–2 mm.

The majority of clinical studies in the PET department continue to be FDG whole-body scans for cancer diagnosis, staging, treatment planning and follow-up. These scans are normally performed with the use of combined PET and CT. Our first PET/CT scanner is a GE Discovery LS, where the PET is a slightly updated version of the Advance PET scanner. The Discovery LS was installed in the autumn of 2001 as the second PET/CT in Europe. In the combined PET/CT examination, the CT scan is used both as a full diagnostic quality CT (including contrast media) and for attenuation correction of the PET images. Today, the Discovery LS has taken over ammonia heart studies from the Advance scanner. Also, some brain projects that have been started on the Advance may continue at the Discovery LS due to the very high similarity of its PET aspects to the Advance scanner.

Our second PET/CT, installed in 2005, is a Siemens Biograph with 16-slice CT. It is run in a unique and well-functioning collaboration with the Department of Radiotherapy, and it is extensively used for therapy planning. A third PET/CT scanner was installed in November 2007 in the new extension of the Finsen building. It has a CT scanner with 40 slices, and the PET axial field of view is extended (in round figures) from 15 to 20 cm. This apparently minor change increases the overall sensitivity by 78% which allows it to be used to obtain (a combination of) lower doses, faster scans and improved images.

The newest PET/CT, which came into routine use during the summer 2009, is a Siemens Biograph 64, identical to the previously described machine except for the extended number of CT-slices (64 instead of 40). It is also installed in the new part of the Finsen building sharing one large control room and the patient facilities with its sister device. So now we have four PET/CT scanners.

Recently a MedRad infusion cart has been obtained, with the intention of reducing (finger) doses to the technologist staff.

In the Cluster for Molecular Imaging, we support the old GE 4096 PET scanner (suitable for larger animals such as pigs), and research scanners for PET and CT of small animals. The PET is a Focus 120 with resolution well below 2 mm, and the CT is a microCAT II, with an ultimate 15 µ resolution.

Søren Holm

Equipment

Equipment	Product	Purchase year
Gamma cameras	Philips ADAC Thyrus	2001
	Mie-Scintron	2004
	Mediso N-TH45-D	2008
SPECT cameras	GE Millenium VG, Hawkeye, low dose CT	2001
	Philips ADAC Skylight	2002
	Mediso Nucline X-Ring-R/HR	2009
SPECT/CT cameras	Philips, Precedence 16-slice	2006
	Philips, Precedence 16-slice	2008
PET scanners	GE Advance	1993
	HRRT Siemens/CTI	2007
PET/CT scanners	GE Discovery LS	2001
	Siemens Biograph Sensation 16 (hirez)	2005
	Siemens Biograph TrueV 40-slice CT	2007
	Siemens Biograph TrueV 64-slice CT	2009
Lung function	Jaeger Masterscreen w/bodybox	2005
	Jaeger PFT pro w/bodybox	2007
Whole body counter	WBC w/NaI counting chamber	1977
	WBC w/plast counting chamber	1978
Cyclotrons	Scanditronix 32 MeV	1991
	RDS Eclipse cyclotron, CTI	2005
NMR	Varian spectrometer 400 MHz	1993
Cluster for Molecular Imaging	Provivo/ ADAC mobile gamma camera	1990
	PET scanner GE 4096	1991
	SPECT Mediso Nucline X-Ring/R	2004
	Siemens Micro-PET Focus 120	2006
	Micro-CT Siemens Micro-CAT II	2006
	Phosphor Imager Perkin Elmer cyclone	2007

The John & Birthe Meyer Foundation has donated all equipment in the PET and Cyclotron Unit.

Rigshospitalet and our Department have been accredited by:

- Center of Excellence by the European Neuroendocrine Tumor Society
- Certified by SIS, National Institute of Radiation Protection, The Danish National Board of Health
- Danish Medicines Agency
- The Danish National Board of Health, MD Specialist education
- EURATOM, The European Atomic Energy Community
- Joint Commission International, the International American accreditation board
- Section of Nuclear Medicine of the European Union of Medical Specialists (UEMS)s "Accreditation of Nuclear Medicine Training Centres Committee", MD Specialist Education. European Association of Nuclear Medicine.
- The Specialty Advisory Committee (SFR) in Clinical Physiology and Nuclear Medicine

Organization Accredited by Joint Commission International

European Medical Research Councils

The European Medical Research Councils (EMRC) is the membership organization of all the European medical research councils – for EU member states as well as all other European countries.

The chair of the Committee for the European Medical Research Councils is Professor Liselotte Højgaard from the Rigshospitalet, University of Copenhagen, Denmark.

The Standing Committee is composed of delegates with a high scientific profile nominated by their ESF Member Organizations involved in biomedical sciences, together with observers from the European Commission, Canada, WHO-Europe, Israel, New Zealand and USA.

In 2009 EMRC disseminated a 'Forward Look' document entitled Investigator-Driven Clinical Trials. This paper has been quoted widely and a workshop in Paris in July 2009 hosted by EMRC has initiated an effective process for strengthening clinical research in Europe under the leadership of Dr. Ruxandra Draghia-Akli, the new Director of EC DG Research Health.

Further, we have worked very hard on the revision of the EU "Animal Directive for Medical Research". Together with members and a broad circle of organizations and researchers we have worked on revising the directive, emphasizing the importance of a dignified and humane approach to research on animals for scientific purposes without hindering research possibilities.

We held the EMRC Annual meeting at the Domus Medica here in Copenhagen, October 2009 and would like to express a warm thank you to the Danish Medical Association for hosting us so beautifully.

A warm thank you to all members of the Plenary and the Core Group of the EMRC, to our ESF CEO Professor Marja Makarow for being present at the Copenhagen Meeting. Thank you to Professor André Syrota, President and Director General of INSERM for updating us on the developments in France.

At the World Health Summit in Berlin, October 2009 the major recommendations from our Forward Look Investigator-Driven Clinical Trials were the subject of a session on Clinical Research. These recommendations were brought forward as the top recommendations from the World Health Summit and handed over to the Ministers of Health and Research in Europe.

It is a privilege for me to accept the nomination for another three-year period as Chair of EMRC.

ESF, Strasbourg

Editors:
Liselotte Højgaard
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Layout and production:
www.bureauLIST.dk / 14820

Fotos:
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Bent Børgesen
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NRC Network University Research Conference

Issues:
1000 ex.

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